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JWARS Space Strategic Partner (JSSPAR) Progress

Report Space Users Group (SPUG) Meeting

11 June 2002

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Outline



- JSSPAR task
- Significant activities
- Workshop results
- Space representation status
- Remaining activities
- Future plans

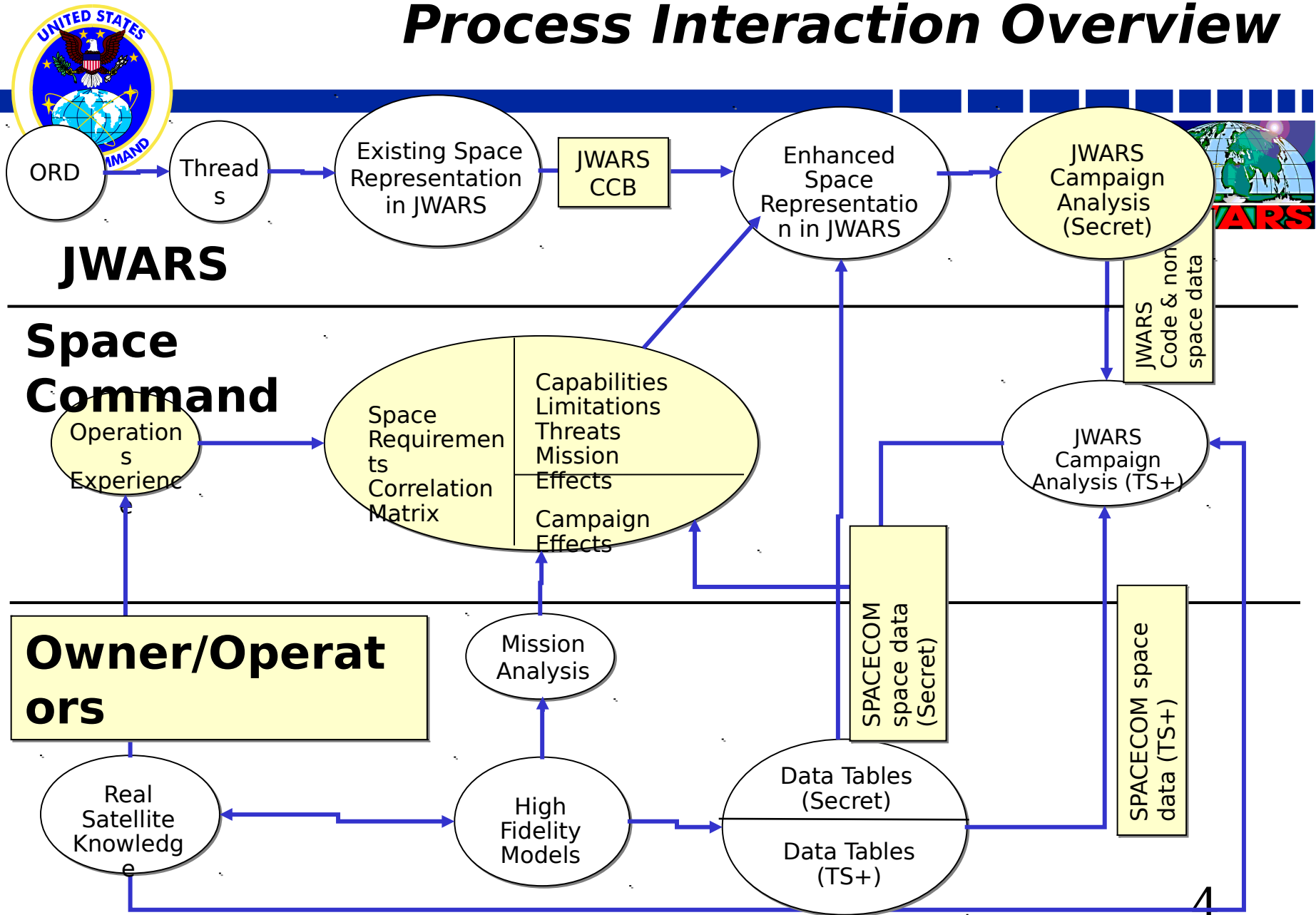


JSSPAR Task Overview



- Assess current space functionality representation in JWARS
- Identify shortfalls and prioritize requirements
- Develop space representation improvement plan
- Begin implementation as resources permit

Process Interaction Overview





Significant Activities



- Conducted joint workshop with JWARS (modeling) and US Space Command (operations)
 - Collaboration on the future functionality in JWARS to adequately reflect how space is used by the warfighter
 - 1-3 April in Washington DC
- Accomplishments
 - Coordinated space functionality assessments
 - Finalized requirements and functionality diagrams
 - Coordinated improvement plan
 - Identified data requirements
 - Established priorities



Workshop Results



- Developed 4 products for each space system
 - Current JWARS functionality (what exists) and shortfalls
 - Functional diagram (what should be)
 - Current enhancement plans (what is planned)
 - Development and data requirements (what is needed)
- Prioritized systems for improvement



JWARS Space Mission Area Assessment



SPACECOM / JSSPAR Priority	Space Mission Area Applicable Space Systems / Sub-Areas	Functionality / Data Sufficiency Assessment		Effort/Time to Implement		Area Addressed in J WARS ORD
	Warfighter Support	Yellow	Red			
1	DSP	Yellow	Yellow	5 ManMo	8 CalMo	TBMD
2	ISR	Green	Red	8 ManMo	12 CalMo	Plan/Collect ISR
3	GPS	Red	Red	5 ManMo	11 CalMo	
4	SATCOM	Yellow	Yellow	6 ManMo	9 CalMo	Communication
	Space Weather Environment	Red	Red	N/A FOR WEATHER		
	Space-Derived Weather	Red	Red			
5	Space Systems Operations	Yellow	Red			
	Space Lift (Access to Space)	Green	Red			
	Satellite Operations (SATOPS)	Yellow	Red			
	Other Space System Applications	Yellow	Red			
	Space-Based Radar (SBR)	Green	Red			Plan/Collect ISR
6	Space-Based Blue Force Tracking (SB-BFT)	Red	Red			Positive Force ID
7	Computer Network Operations	Red	Red			
	Computer Network Attack	Red	Red			Electronic Attack
	Computer Network Defense	Red	Red			Electronic Attack
	Space Control	Red	Red			
	Protection	Red	Red			Counter Space Ops
	Prevention	Red	Red			Counter Space Ops
	Negation	Red	Red			Counter Space Ops
	Surveillance	Red	Red			Counter Space Ops
	Space Warfare	Red	Red			



JSSPAR Recommended Space Priorities



- Priorities for space representation in JWARS include:
 - DSP
 - ISR
 - GPS
 - SATCOM (relates to other space functional areas)
 - Space launch/Space Ops (implicitly through satellite ops in other functionalities)
 - BFT (JWARS assumes perfect SA of blue forces)
 - CNO (can be modeled similar to SATCOM)



SPACECOM / JWARS Position - DSP



Current Functionality:

- Single (vs. stereo) satellite detection vs missile type
- Pd based on ECA and MDS
- DSP detection provides cue to TBMD forces for intercept (active, passive, attack ops)

Shortfalls:

- Only mono satellite (vs. stereo) coverage and Pd considered
- Missile classification not considered (missile typing)
- Cloud cover not considered
- DSP battlespace characterization mission not modeled
- Ground station (Comm path) not modeled

Remedy:

- Incorporate stereo detection
- Include missile classification (SCUD-B vs SCUD-C, etc.)
- Calculate cloud cover based on LOS
- Include battlespace characterization mission
- Add ground station (comm path) to model



DSP "Warning" - fx Diagram



Diagram Deleted

System outputs are shown above, Not current model outputs.
SPACECOM / JSSPAR will determine model MOEs

DSP “Battlespace Character.” - fx Diagram



Diagram Deleted

System outputs are shown above, Not current model outputs.
SPACECOM / JSSPAR will determine model MOEs



DSP - Current Enhancement Plans



- Implement stereo detection
- Utilize cloud data based on cloud height along line-of-sight from DSP to launch site



DSP - Development and Data Needs



- [Deleted]
- [Deleted]
- DSP satellite locations
- DSP satellite reliability by satellite ID
- Min and max processing time by satellite ID
- [Deleted]
- [Deleted]



SPACECOM / JWARS Position - ISR



Current Functionality

- Space-based ISR is aggregated into generic satellite platforms
- Orbits modeled as number passes per day and time per pass
- Dynamic collection plan with user defined planning cycles reacts to changes and new facts from knowledge database

Shortfalls

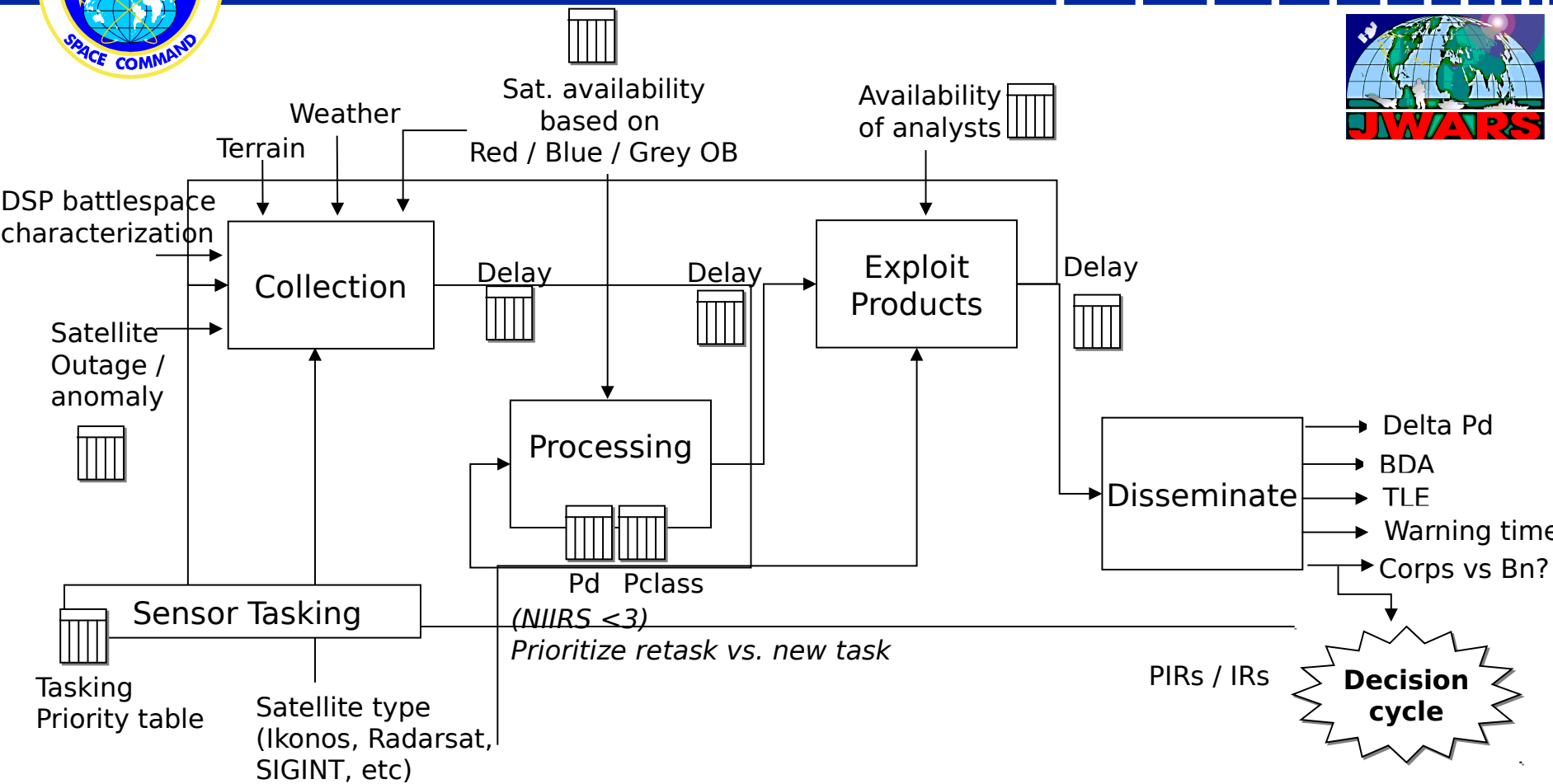
- Model requires accredited data to support ISR functionality
- Collection planning based on targeting is limited
- Limited Denial & Deception modeled (decoy yes, camo no)

Remedies

- SPACECOM working with JWARS JDS for data "points" for extrapolation
- NRO providing some data
- Tie targeting system to ISR system (reverse is already true)
- Incorporate D&D into SPACECOM ISR study to quantify
- JWARS Office will identify the data required for D&D



ISR - fx Diagram



System outputs are shown above, Not current model outputs.
SPACECOM / JSSPAR will determine model MOEs



ISR - Current Enhancement Plans



- Implement staggered observation period function
 - Provides more realistic satellite coverage for LEO and MEO orbits
- Implementing consolidated GUI utility to manage satellite assets within the scenario
- Implementing camouflage, denial and deception for ISR targets



ISR - Development and Data Needs



Analyses:

- Resolution requirements for adequate target ID
 - NIIRS levels needed for count vs identify
- Data processing rates as related to satellite scheduling
- Determination of how much aggregation is right to represent ISR
 - MOPs that adequately define satellite footprints for coverage

Data Resources:

- Collateral data set for testing and general (Non-IC) analysis
 - Has to provide “good enough” ISR performance to not invalidate other non-IC analysis efforts
 - Coordination with NRO not yet yielding results



SPACECOM / JWARS Position - GPS

(also applies to other space-based navigation systems)



Current Functionality:

- JWARS currently assumes perfect GPS system accuracy

Shortfalls:

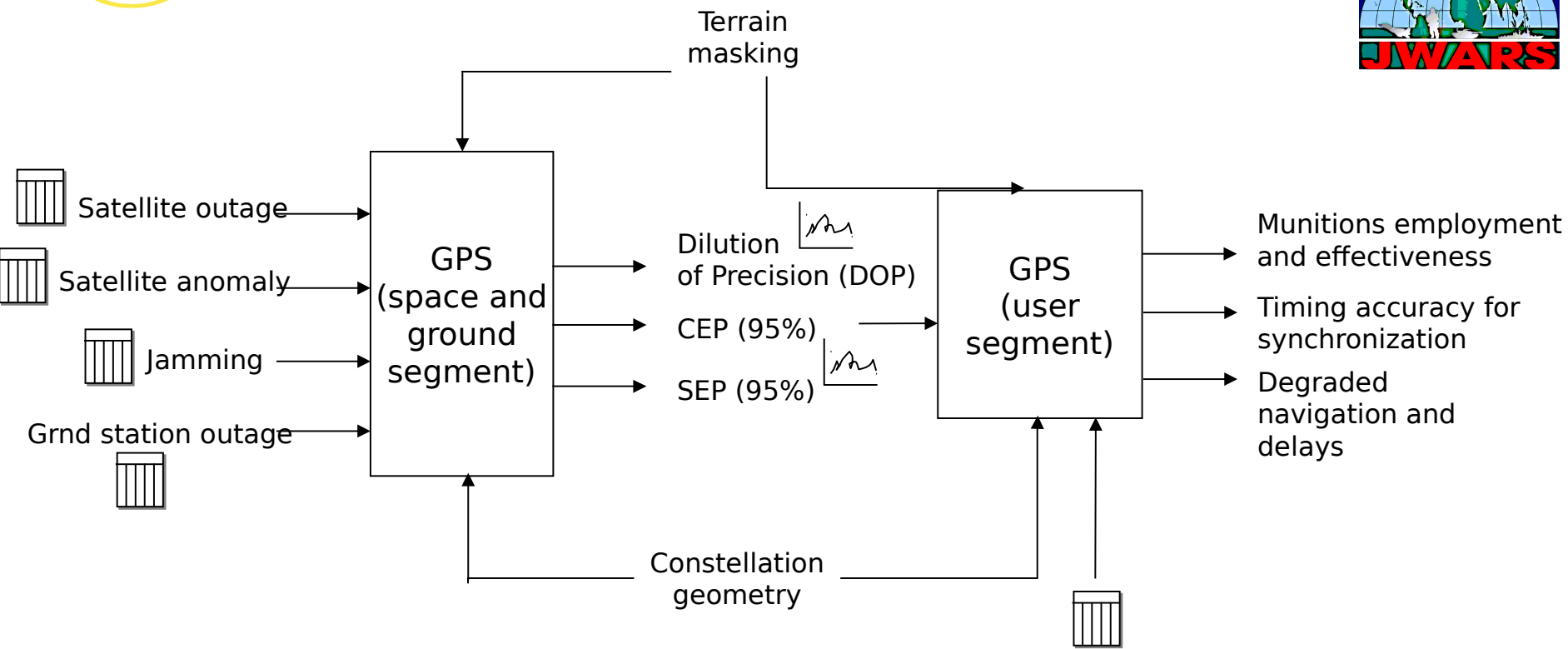
- Lack of the ability to represent navigational errors
- Inability to modify the Pk of GPS guided weapons in a countermeasures environment
 - Degradation to GPS information
 - Denial of GPS information
- Inability to model the weapons selection of GPS guided munitions
- Inability to model GPS derived timing inputs required for secure communications (freq hopping radios)

Remedies:

- Quantify data for GPS effects on specific “conventional” systems
- Implement GPS-caused degraded navigational performance
- Model jamming assets, deployments, and subsequent effects
- Increase situational awareness of hostile forces based on secure communications (freq hopping radios) degrades of friendly forces



GPS "Pos, Nav, & Timing" - fx Diagram



System outputs are shown above, Not current model outputs.
SPACECOM / JSSPAR will determine model MOEs



GPS - Current Enhancement Plans



GPS Munitions Effectiveness:

- Representation of ground based jammer operations and tactics
- Implementation of degraded damage performance of GPS-dependent air-to-ground munitions
- Inclusion of long-range cruise missile and indirect fire operational degrades

Terrestrial Navigation:

- Model representation of navigational delays of terrestrial combat systems in low feature terrain environments
- Implementation of jammer effectiveness zones produced by hostile countermeasures systems
- Identification of ground maneuver susceptibility to GPS navigation degradation

Secure Communications Degradation:

- Identification of combat communications systems and nets requiring synchronization
- Implementation of non-secure backup modes of operation
- Modification of enemy situational awareness resulting



GPS - Development and Data Needs



Analyses:

- Space implementations in similar campaign warfare modeling tools
- Measures of effectiveness employed in lower level models
 - **Critical to the determination of relevant JWARS input data**
 - **Germane to the proper representation of higher fidelity GPS effects**
- Access to mission and campaign level studies of GPS criticality to force enhancement operations

Data Resources:

- Approved suites of modeling tools used to represent GPS performance in benign and hostile battlefield environments
- Potential countermeasures system performance and operational tactics
- Data on terrestrial navigation delays and mission failure scenarios resulting from degraded GPS performance
- GPS guided weapons performance and alternate guidance methodologies



SPACECOM / JWARS Position - SATCOM



Current Functionality:

- Deployment of blue communications assets via TPFDD
- Attrition of communications capability
- Models throughput (bandwidth)
- Control over message routing
- Includes functionality such as jamming, deception, encryption, and interception

Shortfalls:

- Susceptibilities specific to SATCOM assets
- No automatic redeployment / reallocation of SATCOM assets
- Does not include EMCON or “minimize” procedures

Remedies:

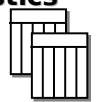
- Include space-based vulnerabilities
- Include SATCOM resource management
- Include EMCON and “minimize” procedures



SATCOM - fx Diagram

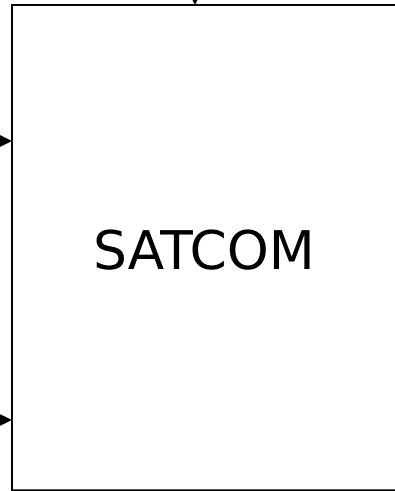
Comm Network Characteristics

- Terminal capacity
- Bandwidth
- TPFDD Flow of Equipment
- Connectivity
- Background traffic
- Priority of allocation



Satellite/ground station anomaly

Message type/content



SATCOM

Satellite Characteristics

- Satellite capacity
- Bandwidth
- Type: UHF, EHF, SHF, other
- DOD & Commercial
- Delta Vector (repositioning)



- Reallocation of capacity
- Message delay (speed of service)
- Network message load
- Attrition of comm equipment



Outputs shown above are current model outputs.
SPACECOM / JSSPAR will determine additional model MOEs



SATCOM - Current Enhancement Plans



- Candidates for Enhancement
 - Simulate dynamic bandwidth (capacity) **load changes** due to demands of:
 - force deployment
 - intelligence
 - combat demands
 - Simulate dynamic **management** of satellite resources
 - UHF and SHF bandwidth allocation
 - Simulate employment DSCS & commercial satellites
 - Based on traffic patterns
 - Accommodate changing traffic patterns caused by arrivals of units and attrition



SATCOM - Development and Data Needs



- Information on functions that cause large increases in satellite message traffic and bandwidth consumers
 - Real time video imagery, satellite snapshot imagery
 - Targeting BDA, intelligence imagery
 - Force deployment, combat phases
- Information of satellite management strategy alternatives



SPACECOM / JWARS Position - BFT



Current Functionality:

- No current JWARS functionality for space-based BFT

Shortfalls:

- JWARS assumes perfect blue force situational awareness
- JWARS assumes perfect blue force combat identification
- Absence of performance effects and the ramifications of degraded operations

Remedies:

- Determine the impact of time delayed reporting on accurate unit location
- Determine the effect of varying error ellipses and element misidentifications as well as false alarms
- Determine the applicability of BFT to sensor and weapons employment (vs. GPS for example)
- Quantify the mission-level impact of having combat identification to military forces
- Implement higher fidelity/dynamic combat resource allocation (AD)
- Perform sensitivity analysis in JWARS

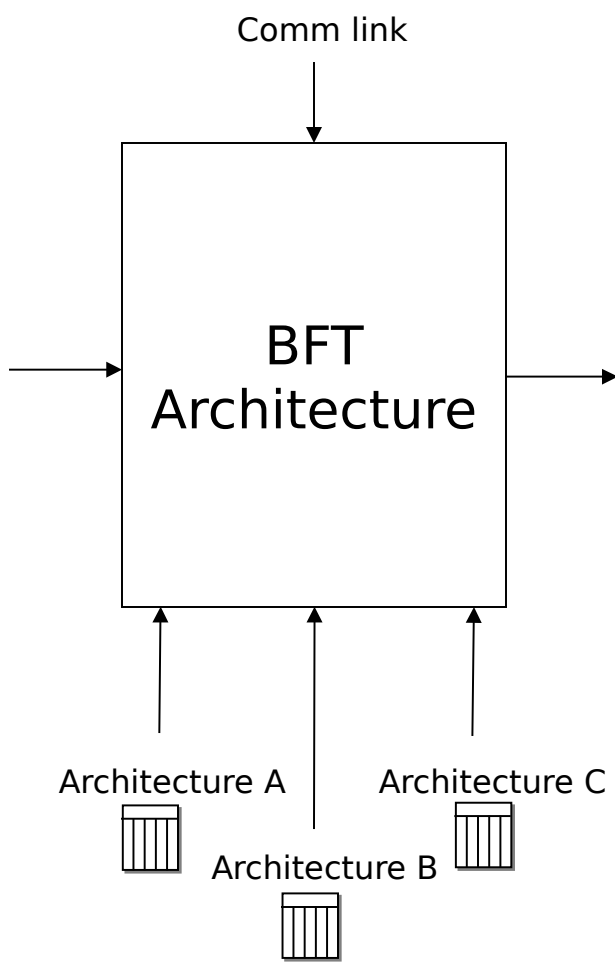


BFT - fx Diagram



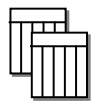
Mitigating Factors

- GPS loss (loss of SA)
- Wrong reported position
- Conventional comm loss
- Poor visibility
- Battlefield confusion
- Time since last update
- Commander's desire to know
- Red / Blue force mixed



Outcomes Affected

- Improved SA to commander
- Decreased fratricide
- Redundant positioning (correlation)
- Overcome effects of low visibility
- Feed to adjacent units
- Improved targeting
- Reduced TLE
- Refined allocation of offensive and defensive assets



System outputs are shown above, Not current model outputs.
SPACECOM / JSSPAR will determine model MOEs



BFT - Current Enhancement Plans



Implementation of an enhanced “IFF/SIF type” infrastructure:

- Representation of interrogator/response elements on combat entities
- Develop a coupled sensor network to detect and track force changes in disposition
- Construction of communications and data networks to manage situational awareness
- Development of backup modes of operations in degraded countermeasures conditions
- Development of the ability to easily construct and modify BFT networks in order to perform trade-off analyses

Development of improved weapons employment zones:

- Implement a higher fidelity representation of weapons allocation
- Induce variations in blue force situational awareness in order to drive force employment and redirection



BFT - Development and Data Needs



Analyses:

- Mission scope, purpose, objective and responsibilities of Blue Force Tracking
- Space operations contribution to the BFT network
- Candidate MOEs/MOPs that will permit proper evaluation of effects
- A complete listing of analyses, reports and white papers that outline the details of the concept

Data Resources:

- Performance and architectures of candidate networks
- Approved metrics to evaluate system performance
- Characterization of space based elements (sensors, relays)
- Characterization of battlefield elements and allocations
- Network command hierarchy and the scope of force redirection



SPACECOM / JWARS Position - Generic



Functionality:

- Space Warfare (Force Application), Other Space System Applications, Space Control, and CNO to be considered later
- Space Wx and Space-derived Wx may not be sufficient to model

Shortfalls:

- Lacks ability to control the availability of satellites
 - Move, Launch
 - Outage / Anomaly due to other events (space Wx)
 - Countermeasures
- BDA Issue: Damaged/destroyed BSEs removed from play

Remedies:

- Include ability to control the availability of satellites
- Define MOEs for Space MS&A
 - Mission-level and Campaign-level analysis
- Leave damaged/destroyed BSEs where they fall
- Identify sources of data



Generic - Status



- Currently no modeling of any of these systems in JWARS
 - Space Warfare (Force Application), Other Space System Applications, Space Control, and CNO
- Scope of representation needs is far more than just “assessment and improvement”
- Further analysis deferred to follow-on effort
- Will develop space requirements and design
 - Joint effort with JWARS and US Space Command



Summary



- Space modeling assessment completed
- Requirements and functional flows developed to reflect warfighter usage of space
- Ready for coordinated approval from Space Users Group (SPUG)
- Ready to begin implementation in JWARS



Remaining Activities



- Current period of performance ends 1 August
 - Complete implementation of DSP model enhancements
 - Coordinate DSP data gathering
- Incremental extension to 31 Oct to align with Government fiscal year
 - Work ISR modeling improvements and data gathering with NRO
 - Begin design of GPS modifications



Planned Activities for FY03



- Coordinate across the space community (Army, Navy, other agencies)
- Refine data requirements details, facilitate data collection
- Validation and assessment of DSP model
- Implement additional space systems in priority order
- Determine how to best model Space Surveillance effects in JWARS
- Programmatic activities



JSSPAR Recommended Actions - Way Ahead



- ✓ 1. SPACECOM
 - Provide access to SMEs to facilitate design of tables that capture sufficient satellite operational parameters for campaign analysis
- ✓ 2. JSSPAR
 - Work with JWARS and SPACECOM to define data tables needed for accurate space representation
3. JWARS
 - Code JWARS to read from tables in advance of actual data
4. SPACECOM
 - Populate data tables with probabilities
5. JWARS
 - Provide data formats to SPACECOM
- ✓ 6. Define follow-on efforts for SOW?



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